Computer Graphics Seminar

MTAT.03.305

Fall 2020

Raimond Tunnel
Contact Information

Raimond Tunnel
jee7@ut.ee
Organizational Information

- 4 introductory lectures
- 6 student presentations
- 5 special seminars
- 1 projects expo (18.12?)

Combine with CG in January?
Organization

- ~16 seminars
  Attendance: ~24h = 0.85 credits

- 1 seminar
  Preparation: 56h = 2.1 credits
  Conducting: 1.5h = 0.05 credits
Organization

- ~16 seminars
  Attendance: ~24h = 0.85 credits

- 1 seminar
  Preparation: 56h = 2.1 credits
  Conducting: 1.5h = 0.05 credits
Organization

• 1 seminar

Preparation: **56h = 2.1 credits**
  - Find suitable material (8h)
  - Read and understand the material (25h)
  - Synthesize a logical approach to the topic (10h)
  - Create a presentation (10h)
  - Practice the presentation (3h)

Conducting: 1.5h = 0.05 credits
Organization

• 1 seminar

Preparation: \textbf{56h} = 2.1 credits

- Find suitable material (8h)
- Read and understand the material (25h 10h)
- Synthesize a logical approach to the topic (10h 2h)
- Create a presentation (10h 5h)
- Practice the presentation (3h)

Conducting: 1.5h = 0.05 credits

- Implement a demo (28h)
CONFUSION
looks better sideways
What do you see?
What about this one?
This one?
You really like cars, don't you?
This has to stop...
Just 2 more, I promise!
Last one!
Bonus question...
The Seminar – Explore a CG topic!
The Seminar – Tackle topics together!
The Seminar – Tell the story!
How to choose a topic?
How to choose a topic?

- What do you need to understand for your thesis?
How to choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?

Ninja Theory developer talking about atmospheric VFX in Hellblade: https://www.youtube.com/watch?v=jdZ1s3FHTFI
How to choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?
- What did you come here to learn about CG?
What do you need to understand for your thesis?
What knowledge will benefit you after the uni?
What did you come here to learn about CG?
What do you find interesting in CG?

How to choose a topic?

What do you find interesting in CG?
How to choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?
- What did you come here to learn about CG?
- What do you find interesting in CG?
What is this?
Post-Processing: the Bloom effect
Back to the main track
How to find materials?
How to find materials?

• The Interwebs.
  • Examples of some quality web articles:
    – GTA V Graphics Study by Adrian Courreges
      http://www.adriancourreges.com/blog/2015/11/02/gta-v-graphics-study/
    – Article lists by Jendrik Illner
      https://www.jendrikillner.com/post/
    – Volumetric Fog by Kostas Anagnostou
      https://interplayoflight.wordpress.com/2015/07/03/adventures-in-postprocessing-with-unity/

• Just Google, but **be critical** about what you find!
How to find materials?

- The Interwebs.
- UT library databases.
  - https://utlib.ut.ee/andmebaasid
  - ACM SIGGRAPH
  - ACM Transactions of Graphics (ToG)
  - IEEE Transactions on Visualization and CG
  - IEEE Transactions on Games
How to find materials?

- The Interwebs.
- UT library databases.
- Books.
  - Fundamentals of Computer Graphics
  - GPU Pro 1-7, GPU Zen
  - Find something and dig in!
How to find materials?

- **The OpenGL Programming Guide (Red Book)** (9th edition)
- **GPU Gems** (1, 2 and 3)
- **GPU Pro series** (1 to 7)
- **GPU Zen series** (1 to ...)
- **Bézier and B-Spline Techniques** – H. Prautzsch, W. Boehm, M. Paluszny
- **Physically Based Rendering: From Theory to Implementation** – G. Humphreys and M. Pharr (3rd edition)
- **Advanced Methods in Computer Graphics: With examples in OpenGL** – R. Mukundan
- **Vulkan Cookbook** – P. Lapinski

**The CGVR Lab's Literature Page:**

## Conditions

<table>
<thead>
<tr>
<th>First time student</th>
<th>Choose any CG-related topic you want.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSc, MSc</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Returning student</th>
<th>Your topic should be related to several scientific articles or books.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSc, PhD</td>
<td></td>
</tr>
</tbody>
</table>

- In either case, **ensure you benefit** from the topic!
  - Eg, that it is related to your thesis or other work.
- Can be the same that others have done before.
Physically-based Shading

\[(1 - F) \cdot \ \vec{n} + F \cdot \ \vec{n} = \]

\[(1 - F) \cdot \ \vec{n} + F \cdot \ \vec{n} = \]
Physically-based Shading
Virtual Reality Game Design

Fixed play areas

- Continuous
- Specific mechanic
- Teleportation

Immersive!

Diegetic

Non-Diegetic

Good for VR

Spatial

Meta
Motion Effects in Adobe After Effects
Procedural Texturing
Rendering Gems

Precious
only 4 gems

- Emerald
- Ruby
- Sapphire
- Diamond

Ray tracing  Proposed method

Adulaerescence  Chatoyancy  Asterism  Aventurescence

Color change  Iridescence  Play of color  Pleochroism
Case Study: Alita: Battle Angel

One eye has 8.5 million polygons for one iris
Node-based Open World Loading and Serialization: Tips and Tricks
Academic Poster Workshop
CGP Projects EXPO

Computer Graphics Project Expo
Spring 2020

On 29.05 from 14:15 to 18:00 in Discord

Use the TEXT CHANNELS to ask QUESTIONS.

In the VOICE CHANNELS students ANSWER your questions and STREAM their project.

Spulkan: Mathias Plans
Automata Sandbox Simulation Carlos Ramos
Procedural Hex Terrain Madis Janne
Side Samurai Markos-Erik Leenem
Models for Animal Evolution Karl-Walter Sillatois

jcarlos 05/29/2020
https://sandspiel.club/

PÅRDIK 05/29/2020
lol and now im playing a game
so where did this idea come to you?
what are your future plans with this?
got em working
just had to restart the program
👏 don't know why i didnt see the mouse
yeah, it didnt show brush at first for some reason
now working, well anyway, nice job i guess 😐 good luck in the future

jcarlos 05/29/2020
Thanks!

343meri 05/29/2020
Gr8 work!

Clyde Today at 11:46 PM
Hello. Beep. Boop. If you wanna invite friends to this server, click the server name in the top left and select “Invite People”. Beep!
Only you can see this — delete this message.

Message #ca-water-simulation
World is a vast and mysterious place!

World is a vast and mysterious place!
Special Seminars

- Industry guests?
- CGVR Lab Field Trip?
- 3D Printing Workshop?
- Ats Kurvet's Job Shadowing?
- ...?
When you have a topic...

- Find, investigate, research
- Examples are good
- Try it out yourself
- Engage others
  - Discussion
  - Interactive demo
  - Workshop
Creating a Presentation
Creating a Presentation

Ensure you understand what you put on the slide!

\[ L_o = L_e + \int_\Omega L_i \cdot f_r \cdot \cos \theta \cdot d\omega \]
Creating a Presentation

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Use big fonts, use your slide space optimally.
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Make the illustrations, drawings, diagrams **yourself**.

![paint.net](https://www.getpaint.net/)

![GeoGebra](https://www.geogebra.org/)
![draw.io](https://www.draw.io/)

![Image of people working on computers](image)
Creating a Presentation

Ensure you understand what you put on the slide!

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Make the illustrations, drawings, diagrams yourself.

Put pictures on the slides!
Creating a Presentation

Ensure you understand what you put on the slide!
Use big fonts, use your slide space optimally.
Make the illustrations, drawings, diagrams yourself.
Put pictures on the slides!
Try to implement what you share.
Creating a Presentation

Ensure you understand what you put on the slide!
Use big fonts, use your slide space optimally.
Make the illustrations, drawings yourself.
Put pictures on the slides!
Try to implement what you say.

The quality should be on par with a thesis level.
Creating a Presentation

Ensure you understand what you put on the slide! Use big fonts, use your slide space optimally. Make the illustrations, drawings, diagrams yourself. Put pictures on the slides! Try to implement what you share. The quality should be on par with a thesis.

You are the master of your topic!
Creating a Presentation

- Ensure you understand what you put on the slide!
- Use big fonts, use your slide space optimally.
- Make the illustrations, drawings, diagrams yourself.
- Put drawings, diagrams etc on the slides!
- Try to implement what you share.
- The quality should be on par with a thesis level.
- You are the master of your topic!
Computer Science: MSc Seminar Module

Goal:

The goal of the module is to give students the opportunity to deepen their understanding of the field most interesting for them and to develop their communication skills.
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Learning outcomes:

After completing the module the student:
- is capable of independent work with modern research literature and other field-related material;
- can effectively communicate his knowledge of the field to others.
Questions?
List of some arbitrary topics

1. **Color blending** – What happens when there are transparent objects in your scene?

2. **Lighting models** – What are the common models? When are they used?

3. **Texturing** – How can one sample from a texture? What artefacts may appear?

4. **Curves** – Why are they important in CG? What about curved surfaces?

5. **Global illumination** – Radiosity, path tracing, photon mapping etc.

6. **Realtime realistic rendering** – Provide an overview of the common methods or pick some effect (light, wetness, fog, fur / hair) and find out how it's rendered realistically in real time.

7. **Non-photorealistic rendering** – Where is it used and how is it achieved?

8. **Tessellation** – How is this done in OpenGL 4+?

9. **Post-processing effects** – What effects are there? When and how are they used?

10. **Procedural generation** – Cover a couple of cool algorithms in depth.
11. Physically-based Shading – What is it? Why is it important to understand physical properties of materials for shading? What games / game engines use it?
12. Rendering in VR – What extra considerations are in VR? How do different technologies overcome them?
13. Vulkan / WebGL 2.0 – What is it for? Why is it useful? How to Vulkan / WebGL 2.0?
14. Subsurface scattering – What is it? How it is implemented? What does it solve?
15. Reflections and caustics – What are the modern techniques, which do those?
16. GLSL vs HLSL – What are the differences? How are both used?
17. Use case study – Find out in detail how graphics are done in one game or movie.
18. Motion capture – What are the difficulties today? Best budget setup for it?
19. Modern GPU architecture – How are GPU-s built? What are they optimized for?
20. Graphics on consoles / smartphones – What limitations are in consoles or embedded systems vs the PC? How are they overcome?
21. **Tileable Textures** – What methods are there for creating those?
22. **Ray Tracing with RTX** – What can be done with Nvidia's RTX cards?
23. **Occlusion Culling** – How is this achieved? What data structures are used?
24. **Volumetric Rendering** – How to simulate volumetric light transport? Fog, fire?
25. **Facial Animations** – What are the modern, cheapest, professional solutions?